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MANIPULATION OF HIGH-CURRENT PULSES FOR HEAVY-ION FUSION*

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For efficient induction-driven heavy-ion fusion, the current profile along a pulse must be modified in a non-selfsimilar manner between the accelerator and the target. In the accelerator, the pulse should have duration of at least 50 ns in order to make efficient use of the induction cores, and the current should be nearly uniform along the pulse to minimize the aperture. In contrast, the optimal current profile on target consists of a main pulse of about 10 ns preceded by a longer low-current "preheat" pulse. This pulse-shape manipulation must be carried out at the final pulse energy (5-10 GeV for 200 amu ions) in the presence of a large nonlinear space-charge field. A scenario for doing the required pulse shaping is presented here and tested numerically. Induction-cell voltages required to shape a pulse in the absence of space charge are first calculated using a highly simplified dynamics model. The longitudinal-control fields needed to balance the beam space charge are then generated by the fluid/envelope code CIRCE, and beam dynamics with the combined shaping and longitudinal-control fields is tested using that code. Finally, the detailed particle dynamics is verified and checked for error sensitivity using the three-dimensional particle-in-cell code WARP3d. Issues of practicality are also discussed.

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